UNUSUALLY RAPID GROWTH OF COASTAL 0+ DUNGENESS CRAB MAY LEAD TO STRONG FISHERIES

Dungeness crab, *Cancer magister*, is the primary crustacean fishery along the west coast of the United States from northern California through Washington, and is characterised by cyclic landings with a periodicity of 9 to 10 years (Botsford *et al.*, 1989). Despite numerous hypotheses to suggest a suite of biotic and abiotic factors as explanations for such cycles, no cause-and-effect relationship has been demonstrated as responsible for high or low year class abundance. Although larval production, transport, and settlement to nearshore areas are assumed to be critical for high juvenile abundance, year class strength is often not determined until the 1+ age class since mortality of early benthic instars is very high. In previous hypotheses, Armstrong and Gunderson (1985) believed that estuarine recruitment of juveniles was essential to production of a strong year class because growth is more rapid in these systems than along the colder (upwelling) open coast, and estimated abundance of 1+ juveniles is usually greater in estuaries compared to the coast.

Since 1983 we have measured timing of settlement, growth rates, movement, and relative abundance of juvenile Dungeness crabs along the southern Washington coast in a stratified survey program intended to contrast population dynamics across several habitats within the estuaries of Grays Harbor and Willapa Bay and along the nearshore (inside 70m) coast. During this time we have measured at least two very strong year classes as 1st instar, 0+, crab; one of which had very low subsequent survival and produced an average fishery, and one that produced a record fishery 4 years later.

Megalopae settle along the nearshore coast and in estuaries, and mortality is generally rapid in both systems. Estimates of 0+ juveniles within the survey areas shown by Gunderson *et al.* (1990) have varied by at least 14 times, and in most years initial summer survival seems to be highest in estuarine intertidal shell habitat. As a consequence of estuarine settlement, 1+ abundance is typically high the following year and this cohort is joined by siblings that immigrate to the estuary from the open coast, thereby decreasing the summer abundance of juveniles in colder coastal waters. Summer estuarine abundance has varied by only about 2 times between 6 to 12 million crabs in a system like Grays Harbor.

Year class strength as reflected in the fishery was discernible during the period of our study. Six of the worst commercial years on record occurred between 1980 and 1987 (1,400–1,800 t), but some of the largest landings for Washington state were in 1988 (7,500 t) and 1989 (10,000 t) which corresponds to a 3.5 and 4.5 year lag back to the 1984 year class (YC) that entered the fishery over a two year period. Reasons for this strong YC are not based on extraordinary events in the estuaries where 1+ abundance was consistent with values from all other years. Rather, the coastal cohort of the 1984 YC was exceptionally strong and survived well for two apparent reasons. Firstly, the YC settled in strength early that year in May whereas other YC's typically do not fully recruit until late June to early July. The effect of early settlement was essentially a longer growing season. Secondly, bottom water temperatures in May and June were about 1.5°C warmer than six year monthly averages. As a result, 0+ crab of the 1984 YC were about 22–25mm carapace width (CW) by September compared to a range of 12–14mm CW in most years. Substantially larger size by the end of summer protected the 1984 YC from continued high predation that usually decimates a coastal 0+ population by the following spring.

Measured as 1+ abundance in spring the year after settlement, the 1984 YC ranged in abundance from 29–100 million juveniles along the coast compared to 1–10 million in other years. Thus coastal fisheries of low to moderate yield may be largely based on fairly stable estuarine production of juveniles, but very large fishery peaks that characterise Dungeness crab could result from auspicious coastal conditions and early settlement that, in this case, led to accelerated growth of coastal 0+ juveniles in 1984. Related to this observation is the perspective that strong onshore larval abundance and subsequent settlement do not often equate to a strong YC since 0+ mortality is extremely high. Larval retention and/or transport onshore is only a first-stage ingredient for a strong YC that is also based on survival of 0+ juveniles.

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